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Christophe Starzec, François Gardes. Measuring inflation under rationing: A virtual price approach. 2014. halshs-00941780

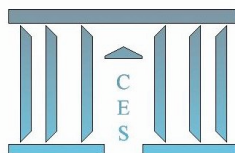
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**Measuring inflation under rationing: A virtual price approach**

Christophe STARZEC, François GARDES

**2014.01**



# Measuring inflation under rationing: A virtual price approach

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## Résumé

La présence de rationnement ou plus généralement de situations de la demande contrainte rend la mesure de l'inflation contestable et donne une fausse image de la réalité. Dans cette recherche on utilise l'approche de prix virtuels de Neary, Roberts (1980) pour estimer le niveau réel de l'inflation dans les pays à économie centralement planifiée (CPE) avec les prix administrés. Dans la première partie du papier on discute différentes méthodes d'évaluation du niveau de l'inflation dans les CPE à l'aide des indicateurs de déséquilibre ou des proxys qui prennent en compte le rationnement et l'information incomplète. Dans la deuxième partie du papier on applique l'approche de prix virtuels (Barten 1994) et Neary, Roberts (1980) qui permet d'identifier le coût réel d'achat des biens rationnés. Sans surprise les résultats montrent une grande différence (jusqu'à 500%) entre le prix officiel de l'alimentation considérée comme le bien le plus sévèrement rationné. L'expérience naturelle de la transition en Pologne en 1990 de l'économie planifiée à l'économie de marché (de rationnement au marché en équilibre) a confirmé l'ampleur de la différence entre le prix officiel (administré) et le prix de marché.

## Abstract

The presence of rationing or more generally of the situations of constrained demand can make the traditional methods of measuring inflation questionable and give an erroneous image of the reality. In this paper we use the virtual price approach (Neary, Roberts, 1980) to estimate the real inflation level in a centrally planned economy (CPE) with administrated prices. In the first part of the paper we discuss various methods used in CPE's to evaluate the real level of inflation by the market disequilibrium indicators or proxies which take into account rationing and incomplete information. In the second part of the paper, we apply the virtual price approach to compute the real inflationist gap between demand and supply under rationing in Poland's centrally planned economy with administrated prices in 1965-1980 period. We estimate for this period the model of consumer behaviour under rationing and recover the virtual prices reflecting the real cost of purchasing rationed goods following Neary, Roberts' (1980) and Barten's (1994) methodology. The results show a very large difference between official and virtual price of food considered as the most rationed good (up to 500%). The natural experiment of shift from the centrally planned economy to the market economy (or from rationing to market equilibrium) observed in Poland during the "shock therapy" (1990) confirms the scale of estimated by the model gap between the official (administrated) and market prices.

Key words: Consumer demand, rationing, inflation, virtual prices  
JEL: D12 D45 E31 P36

## Introduction

Inflation in centrally planned economies with administrated prices and high subsidies for primary goods has not exactly the same meaning that in market economies. Moreover the structural disequilibria with permanent rationing both on the production and consumption sides makes the analysis and measuring of the inflation very difficult and hazardous. The situation can be even more peculiar in the case of coexistence the state owned and planned economy as a whole with almost totally or partially privatized sectors like agriculture and small business (for exemple Poland and Hungary). The degree of openness of foreign trade on the free market countries was also an important factor in shaping the evolution of administrated prices. Again Poland and Hungary appear as the most open countries especially in seventies when compared with highly autarkic model of the Soviet economy.

The period of seventies is known for its global economy specificity essentially because of the petrol shocks and their consequences. Both market and planned economies were concerned by inflationist tensions created by petrol price dramatic increase and all economies adopted different forms of austerity measures. However, for socialist countries and especially those relatively open to the international trade, a new opportunity appeared in form of abundance of “petrodollars” from oil exporting countries available in form of cheap credits.

Poland had largely took advantage of the “recycling” of petrodollars process and contracted very important amounts of credits to boost the investment and imports of consumption goods. The structural difficulties of competitiveness in planned economies combined with the increasing weight of foreign debt in public finance led in the end of seventies to the major economic and social crisis. The popular protests against the rise in prices in 1976, then Solidarnosc revolution in 1980 followed by the state of war, were the most dramatic events which finally led to the collapse of the communist regime in Poland.

In this paper, first we discuss the meaning of inflation in centrally planned economies (section 1), then we present various methods to evaluate its real level completing the official figures by market disequilibrium indicators or proxies which take into account rationing and incomplete information (section 2). A few examples of evaluation the real level of inflation or of the gap between observed and reported level of prices are given in section 3. The last 4<sup>th</sup> section presents more general method to measure the market disequilibrium effects on the consumption and prices based on virtual prices concept applied to the total consumer’s budget in constrained market situation. We follow the approach proposed by Neary and Roberts (1980) to model the consumer behaviour under rationing and we estimate this model for Poland in 1965-1980 period using Linear Expenditure System (LES) specification. This method allows the evaluation of rationing effects by comparison of constrained and unconstrained demand functions and using the substitution effects. The estimated virtual prices and their evolution are compared with official price indexes. The difference between them in level and tendency shows the size of the gap between the official price and consumer’s virtual price for a given rationed good and can be interpreted as the size of underestimated inflation observed with official, administrated prices. The model was estimated considering food and clothing as the constrained goods.

### 1. What does it mean inflation in Centrally Planned Economies (CEP)?

In Centrally Planned Economies (CPE) inflation was defined as “a disequilibrium between supply and demand. When the demand is excessive with respect to the supply it may lead to an increase in prices and to the money depreciation” (Encyklopedia Ekonomiczna 1974). The interesting nuance in this definition is the verb “may”. It means that in the situation of fixed arbitrary (administrated) prices the distortions between demand and supply is not necessarily reflected in the officially reported prices.

In Market Economy Countries (MEC) inflation is defined as “an increase in prices of goods and services in monetary terms”. Practically it is computed for a selected basket of goods and services (Dictionnaire des sciences économiques, 2001) following Friedman and Hayek works. The interesting nuance in this definition is the expression “in monetary terms”. It means that can be other than monetary means to appreciate the change in prices. In market economies inflation measures the observed changes in monetary prices of goods and services, while in CEP countries the inflation is the evolution of administratively fixed prices which do not necessarily follow the supply-demand distortions.

Interesting detail from the historical point of view for both definitions is that they do not mention the necessity of taking into account in inflation measures the evolution of the price of financial assets. This problem was stressed as early as in 1920 years in Soviet Russia (!) by Ignatiev and Konjus (1925).

For quantitative research the definition of inflation in CPE countries should be formulated to take into account both their formal, systemic particularities as well as the limits of available information on prices. Many discussions about the meaning of inflation in CPE countries (Seurot 1983), led to the formulation of definitions based on the demand – supply distortions and their measures. The most general was the one of Rueff (1962) : “the inflation is simply the demand without supply “ or the more precise formulation by Zaleski (1974) that “the inflation is the disequilibrium between purchasing power created (at the given level of official prices) and available resources”. The main difficulty to use these definitions is the impossibility to find the adequate measures for both demand ( or purchasing power) and resources in absence of reliable prices. This is the main reason why in CPE countries it is possible to have both the stable or even decreasing official prices and the rising excess demand and diminishing purchasing power. Thus, when discussing real inflation in centrally planned Poland context we will have in mind essentially demand - supply distortions rather than the official price evolution and the depreciation of the local currency.

#### *Limits of informative role of the official prices in CPE countries*

In CPE countries, by construction, the prices observed in official statistics reflect to a very limited extent the market realities. The production prices result in simple addition of firm costs and the rate of the profit fixed by the state. Detail prices are also largely independent of demand: they can play a role of incentive (in presence of subsidies) or taxation role for luxury goods. In all cases the prices can be independent of costs. So the evolution of detail prices does not follow necessarily the costs evolution. This kind of system of price formation generates disequilibria because it is not supposed to follow demand - supply distortions. In this sense the prices have no informative function like this is the case in market economies. The peculiar mechanism of price formation associated with the mechanisms generating shortages both in production and consumption sectors were exhaustively describe by Kornai (1980) in a more general analysis of the centrally planned socialist economies.

This situation can be slightly different from one country to another with respect to the role of some market mechanism present in a given case. Table 1 gives the official general price

indexes for three countries: Hungary, USSR and Poland. USSR is the most orthodox planned economy country where the prices can show the evolution completely disconnected from the market realities. On the other hand Poland and Hungary represent still an administrated price evolution but in these countries the price policy takes into account to a larger extent the demand supply adjustments because of the presence of relatively large private sector. The comparison among these three countries shows relatively high price variability in Poland and Hungary when compared with remarkably stable prices in the Soviet Union.

Table 1  
Official annual price indexes 1965-1980  
for Hungary, Poland and USSR

Year	Poland	USSR	Hungary
1965.	0,8	-0,7	1,3
1966.	1,3	-0,7	1,8
1967.	1,5	0	0,6
1968.	1,5	0,1	0
1969.	1,2	0,5	1,2
1970.	1,1	-0,2	1,1
1971.	0	-0,1	2,3
1972.	0	-0,1	2,9
1973.	2,8	0	3,2
1974.	7,1	-0,1	2,2
1975.	3	-0,1	3,6
1976.	4,4	0	5,1
1977.	4,9	0,3	4,1
1978.	8,1	0,7	4,9
1979.	7	1,3	9,7
1980.	7,8	1	8,9

Source; Seurot 1983, Statistical Yearbooks Hungary, Poland, USSR

Several symptoms of market situations can bring some complementary information about the gap between the official price record and the economic reality:

*Hidden increase in official prices:* It is operated by the change of the quality norms of goods entering to the price index. This was the case in Poland for example for chocolate (genuine cacao proportion) or sausages (meat / water ratio). Thus even administrated official prices can be manipulated for political reasons.

*Queuing :* the allocation of goods is made following the rule “ first arrived first served”, by inscription on a more or less formal list , or by administrative procedures of priority. The absence of queuing is not always the signal of equilibrium. On the contrary, in the case of the total shortage the queue disappears and the demand is transferred to other goods or to the forced saving.

*Rationing* : the prices do not rise but the goods allocation is made by administrative procedures rather than by market (rationing tickets – the case of sugar in Poland in 70 ties ), vouchers - distributed by the administration on the merit base to obtain an unavailable good ( for example cars in Poland) .

## **2. How to evaluate supply - demand distortions without the reliable prices**

Several approaches were proposed to find the adequate proxies for inflation measures in the situation of systematic excess of demand over the supply in absence of the market prices. Some of approaches propose only typical indicators of market disequilibria in planned economies others go further trying to quantify the gap between the equilibrium situation and the observed market conditions.

Generally in both cases what is needed is the reference market situation which can be compared with the observed one. The coexistence of different “markets” of various degrees of demand constraint (rationing) allow some evaluations. This is certainly the case countries like Poland and Hungary with a significant private sector (especially agriculture) where various parallel markets were coexisting on different segments of consumption goods and at various level of prices .

*Difference between the official prices in the state owned commerce and the prices on a free or parallel markets.*

Unsatisfied demand in the state owned commerce can shift to the other markets more or less formal. For example in Poland these parallel markets were legal when they concerned food or craft products or services furnished by individual private business. Similarly almost all products unavailable on official market were sold by state in the special shops with payment made with the convertible foreign currencies. These currencies were available on informal, but tolerated market. Less formal way to get a rarely available good or service was the payment of a tip to the employee of the state shop. The amount of this tip can be considered as rough approximation between equilibrium and official price.

*Existence of forced savings*

The hypothesis behind this proxy of unobserved inflation is that in the case of market disequilibrium or rationing the rate of saving can be higher than expected at a given level of incomes. This is reasonable assumption, but again only officially registered saving in saving banks can be observed excluding hidden individual cash saving.

*Existence of state owned special shops networks.*

The goods and services rationed on the official, regular market can be available only to some privileged categories of population. In almost all socialist countries there were two types of this kind of networks: “Nomenclatura” one for communist party or government high and medium-level VIPs, and the other one for holders of foreign convertible currencies. In Poland the informal market for foreign currencies exchange was generally open to everybody who was able to buy or to earn the foreign convertible currency. The access to these networks was equivalent to the possibility to buy a large selection of goods not available on the official market or available with queuing.

*Existence of the system of credit to producer ( a queuing scheme, with a credit advantage to the producer: pay and wait)*

This rule was very frequently used especially in durables commerce. The client pays the total or partial price of the good and wait the necessary for producer time for the shipment. The waiting time could be very long – even several years in case of cars. This is a typical characteristic of the



market dominated by the producer in market economies as well. It is the consumption credit in reverse order.

*Increasing subsidies to the prices.*

In order to maintain the prices stable, when the costs are increasing, states were obliged to increase the subsidies originally devoted to guarantee the low level of the prices for the basic goods. The system can lead to the strange distortions especially in the case of coexistence of private and state sectors. In Poland in the late seventies, feeding cattle with highly subsidized bread might have been cheaper than buying fodder from the state agencies. Thus, subsidies and their relative importance with respect to the market price of the good can also be used as a proxy for inadequacy of reported prices change and the real one. In the end of 70ties, in Poland the rate of subsidies was about 30% of the total amount of food consumption in the country (Economic Survey of Europe in 1978). It is not easy to take into account it to correct the reported price indexes, but the higher level of the subsidies the larger difference between the observed, official prices and the market realities.

Some of the situations described above are not very easy to measure in terms of impact on real price index. Measuring the size of discrepancies between observed and really paid prices, including all hidden costs, needs some specific approaches. The appropriate methods should compare prices simultaneously in constrained and unconstrained demand situations in *ceteris paribus* conditions. This is a difficult problem, which can be solved by the use of an intermediate indicator (proxy) having common meaning for the compared situations.

### **3. A few examples of comparisons of official and estimated price indexes in Poland (Seurot 1983)**

*Parity of Purchasing Power (PPP) and foreign currencies exchange rate on informal market.*

Culbertson et Amacher (1978) proposed an interesting comparison between the evolution of exchange rate of convertible currencies in the country and the corresponding Purchasing Power Parity (PPP). The increasing discrepancies between them are interpreted as a gap between official and real inflation rate. For Poland for the period 1960-1970, the estimated this way inflation rate was almost 5 times higher than the official one (550% and 120% respectively). The main drawback of the method is the reliability of the observed exchange rate of foreign currencies. In Poland in presence of almost legal foreign exchange market this estimation could be less biased than for other CPE countries. Similar approach was proposed by Laski, Brus (1985) comparing Purchasing Power Parity between Poland and Austria. They evaluate for example that the real increase in prices in 1973 was 3.4% to be compared to 1.1 % by official indexes.

*Dollar's free (informal) market exchange rate*

Convertible currencies, especially the dollar's exchange rate can be considered as an indicator of the price for entering the consumption goods and services market in quasi equilibrium (Starzec 1983). This approach uses the assumption that the exchange rate of foreign currencies can be a good proxy for the gap between official and equilibrium prices when they can be used to buy on the legal segment of market in equilibrium. In this case the price of the foreign currencies gives the opportunity to access to the almost equilibrated market and their price (exchange rate) is the cost of entering on the market in equilibrium. This is a simulation of the price formation on the market in equilibrium on the constrained market observed through the evolution of dollar's exchange rate. The used example is the comparison of the transactions prices on the car market in 1981-1982 period, when the price control was relaxed. Month by month differences between the

official index, and dollar's free market price shows the evolution of the prices measured with state controlled prices and market equilibrium price index. Associated car price index (Fiat 126p) can be interpreted as an intermediate price index taking into account both the transactions at official prices and free market ones (Table 2 ).

Table 2  
Formal and informal price indexes  
1981-1982, base January 1981

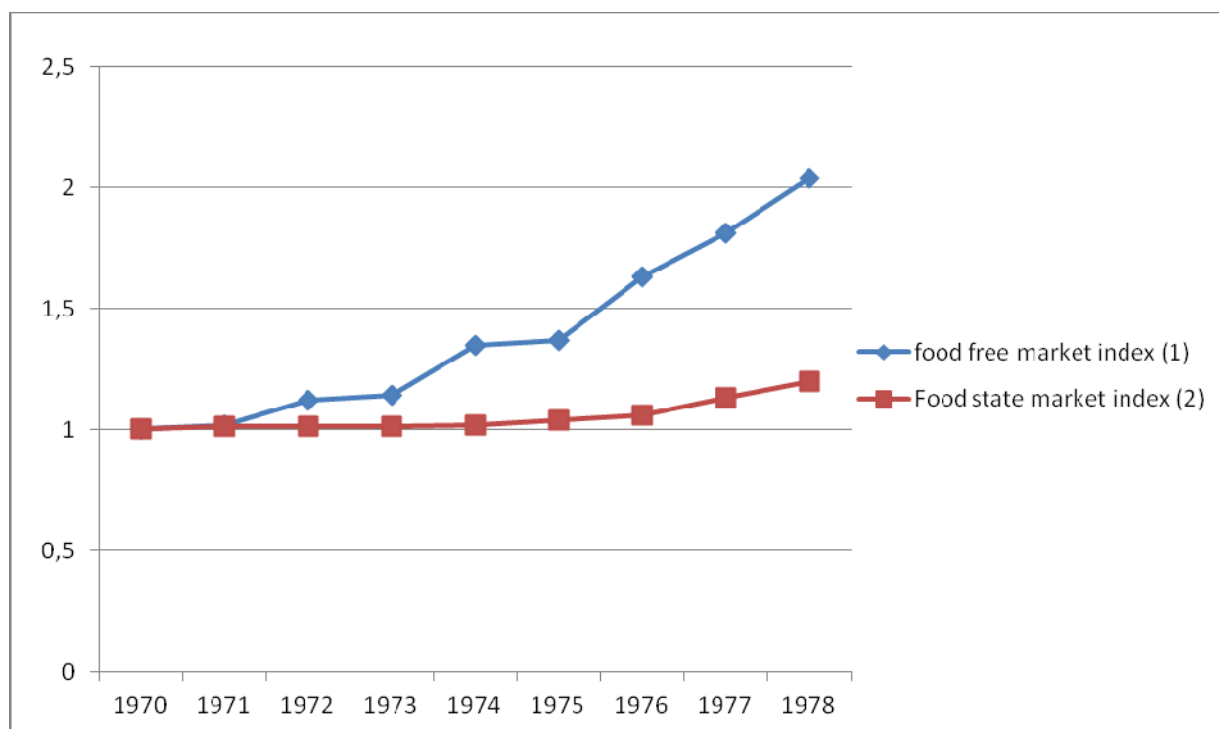
months 1982	official price index	Dollar's price index	Fiat 126p index
January	153	384	262
February	216	300*	190
March	237	230	195*
April	237	240*	195
May	240*	269	200
June	243	320*	205*
July	250	376	210
August	255	403*	210
September	280	423	214
October	280*	423	214
November	290*	446	309
December	310*	460*	309

\* Estimated values

*Observed differences between the prices in state commerce and coexisting free markets.*

If the private free markets coexists in a country together the state owned commerce, comparing prices between them can give a good estimation of the effects of price control, disequilibrium and rationing on the real price index. In Poland private production of goods was limited to agriculture and craft. The comparison between food prices on the free(private) and state markets in the period 1970-1978 shows a large and quickly increasing difference the respective price indexes: 20% for official index and 200% on free market one. Even in not completely comparable (does not cover the same basket of goods) it gives a good estimation of the scale of the phenomenon.

Graph 1  
The comparison of the evolution of food price indexes on the official and free market  
Poland 1970-1978, Base 1970



Source: Rocznik Statystyczny 1971-1980

#### *The indicator of the forced saving.*

Forced saving (inflationist surplus) is the effect of the unsatisfied consumer demand resulting from the supply distortions without market price adjustment. In it can be observed by the comparison of the saving rates in the equilibrium and disequilibrium situations. Gomulka (1979) computed for Poland the rate of saving evolution in Poland from 4.5% in 1972 to 14.4% in 1978. The rate of saving considered as « normal » is about 3%. Whatever the somewhat arbitrary level of “normal” saving rate, its evolution in the seventies shows the increasing problem of demand- supply distortions at the given level of administered prices.

#### **4. The virtual price approach to estimate Poland’s inflationist gap for 1965-1980 period**

All discussed above methods give some indications about the distance between the observed evolution of formal, administered prices (or the level of official inflation) and the prices which take into account different obstacles to the access on the supply-demand equilibrated markets. They can give a partial evaluation of an extra necessary cost to obtain a rationed or absent from official market goods. Partial, because based on symptomatic, indirect indicators which focus only on one characteristic of markets in disequilibrium in presence of administered prices and do

not take into account the global consumer budget allocation problem between more or less available goods which compose the whole consumer's basket.

More general approach consists to integrate into consumer behaviour model *all*, not always observable, constraints and opportunities to realise the optimal consumption program. This can be particularly the case in different types and degrees of rationing. The concept of virtual prices suggested and developed by Neary and Roberts (1980) allows the use of the unconstrained demand functions to derive the consumer behaviour function under rationing. They generalised the results of Tobin and Houthakker (1950-1951) on the relationships between rationed and not rationed demand functions. The virtual price can be seen as "the corrected" by the rationing circumstances price which the consumer is supposed to pay taking into account the market availability of the good. From the point of view of consumer demand theory it consists to maximise the consumer's utility not only under the budget constraint but also under the good availability constraint. The Slutsky type equations are used to decompose the derivatives of the rationed demand functions into income and substitution effects. Then, the difference between the virtual price on the rationed market, and the official administrated price can be interpreted as an extra cost which includes different types of exogenous and endogenous constraints and opportunities faced by the consumer. For example, the virtual price of a good which is rationed by queuing will be higher for a consumer constrained by the time or with high time opportunity cost than for a consumer with no time constraint or with low time opportunity cost. Generally this individual situations and corresponding virtual prices are not directly observable without detailed microeconomic information, but they can be derived on an aggregated level by comparing the situations of constrained and not constrained demand (Neary, Roberts 1980, Barten, Bettendorf 1995).

*Poland's inflationist gap for 1965-1980 by virtual prices approach (Neary, Roberts (1980))*

In this part of the paper we use the (Neary, Roberts (1980) model of virtual prices to estimate the gap between the officially reported prices and those derived from the change of consumer's behaviour under rationing. This gap can be evaluated by an estimation of the really confronted prices including the extra costs due to the rationing or limited availability of goods on the market. For model specification we choose the Linear Expenditure System (LES) proposed by Stone (1954). Other specifications are possible. In the case of rent rationing before the war in Belgium, Barten and Bettendorf (1995) use for example the Rotterdam and CBS demand system specifications. The choice of LES can be justified, by its parsimony in parameters to be estimated, the possibility to derive the level of the virtual prices directly from estimated parameters and also, by an interesting interpretation of its parameters in terms of necessary and excendetary expenditure adapted to the Polish situation where the considered rationed goods (food, clothing) were essentially necessary goods representing a very large shares of the total budget (respectively 0.55 and 0.16 at the mid-period).

### *The estimated model*

Linear Expenditure System (LES), proposed by Stone (1954) can be derived from Stone-Geary utility function.

$$U = \prod_i (q_i - \gamma_i)^{\beta_i}$$

with  $q_i$  quantity of the good  $i$ ,  $\gamma$  and  $\beta$  parameters.

The  $\gamma$  is considered as a subsistence quantity of good  $i$ . The difference between  $q$  and  $\gamma$  is considered as a supplementary quantity of good  $i$  beyond the subsistence quantity.

The demand function for LES can be written:

$$q_i = \gamma_i + \beta_i / p_i (y - \sum \gamma_j p_j)$$

with  $p_i$  the price of the good  $i$  and  $y$  the total expenditure.

Multiplying both sides by prices we obtain the demand functions:

$$p_i q_i = p_i \gamma_i + \beta_i (y - \sum \gamma_j p_j),$$

where  $p_i q_i$  is the expenditure on good  $i$ ,  $p_i \gamma_i$  is the subsistence expenditure on a good  $i$ ,  $\beta_i$  is a marginal budget share,  $y$  the total expenditure and  $\sum \gamma_j p_j$  the total subsistence expenditure.

In the rationed demand context with one rationed good the unconstrained demand functions can be written:

$$p_i q_i = p_i \gamma_i + \beta_i (y - \sum p_j \gamma_j - p^0 \gamma_0), \text{ for } i = 1, \dots, n-1, \quad (1)$$

where  $p^0 \gamma_0$  is the subsistence expenditure on rationed good with  $p^0$  the price of rationed good.

The demand function for rationed good can be written:

$$p^0 r = p^0 \gamma_0 + \beta_0 (y - \sum \gamma_j p_j - p^0 \gamma_0), \quad (2)$$

with  $r$  the quantity of rationed good

Then constrained demand functions in the case of one rationed good are:

$$p_i q_i^r = p_i \gamma_i + \beta_i (y + (p^v - p^0) y^r - \sum p_j \gamma_j - p^v \gamma_0), \quad (3)$$

with  $p^v$  virtual price of rationed good,  $p^0$  the price of rationed good,  $y^r$ —rationed total expenditure.

Using formula for virtual price:

$$p^v = \beta_0 (y - \sum p_j \gamma_j - p^0 y^r) / (1 - \beta_0) (y^r - \gamma_0) \quad (4)$$

the previous equation can be rewritten in terms of observable exogenous variables only

$$p_i q_i^r = p_i \gamma_i + (\beta_i / (1 - \beta_0)) (y - \sum p_j \gamma_j - p^0 y^r) \quad (5)$$

The equation (5) was estimated for the whole unconstrained expenditures budget and its parameter estimates were used to compute the virtual prices (4) for constrained goods of food and clothing.

The model was estimated for the period 1965-1980. We use the data on consumption and official prices for five groups of goods (*Rocznik Statystyczny* from 1968 to 1982). Two groups - food and clothing are considered as rationed, others (housing, energy, others) are considered as not rationed. This is somewhat arbitrary hypothesis because in fact all goods are concerned by different degrees of rationing. Food and clothing are simply considered as more rationed than other items.

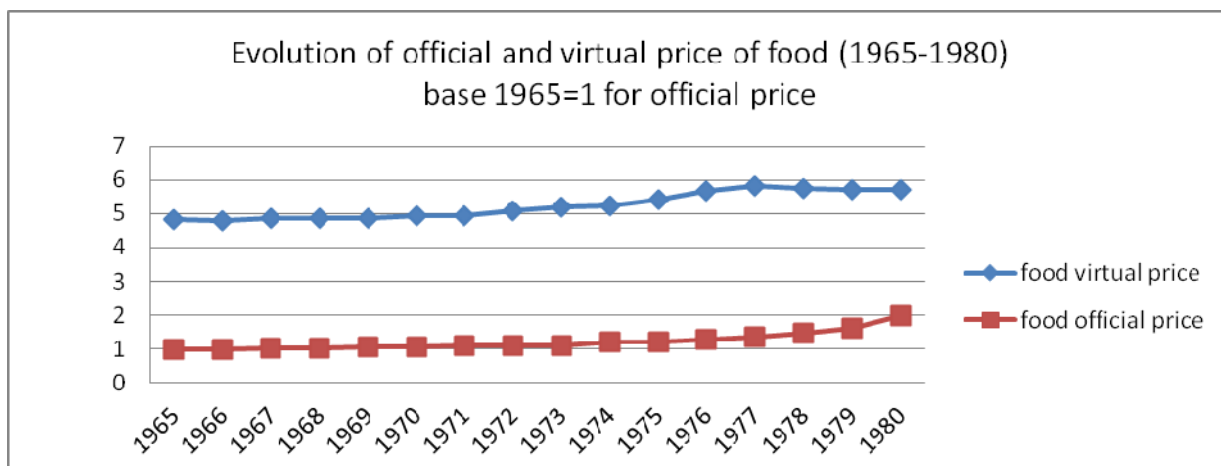
#### *Estimation results*

The estimation results of the model are in Appendix 1. They are statistically correct with acceptable standard errors and the global goodness of fit. The Graph 2 shows the comparison of the evolution of formally reported administrated price index and the evolution of virtual prices using estimated model for each year. The gap between two curves can be interpreted as an extra cost necessary to purchase food taking into account various constraints due to different forms of rationing at a given level of official prices. This gap is very large and varies during the considered period. It is almost three times higher for food than for clothing (see Graphs 2 and 3). For food the virtual price is almost 5 times higher than official price. For clothing the difference is much lower. The virtual prices are less than two times higher than officially reported ones. For both food and clothing we observe a practically constant pattern until 1971 and then the differences between the virtual and official prices are diminishing. The last tendency is much stronger for clothing especially starting from 1975-1976. The ratio of the virtual and reported official price is diminishing over this period (Graph 4). The evolution of this ratio coincides with the slow movement of the official prices towards market situation.

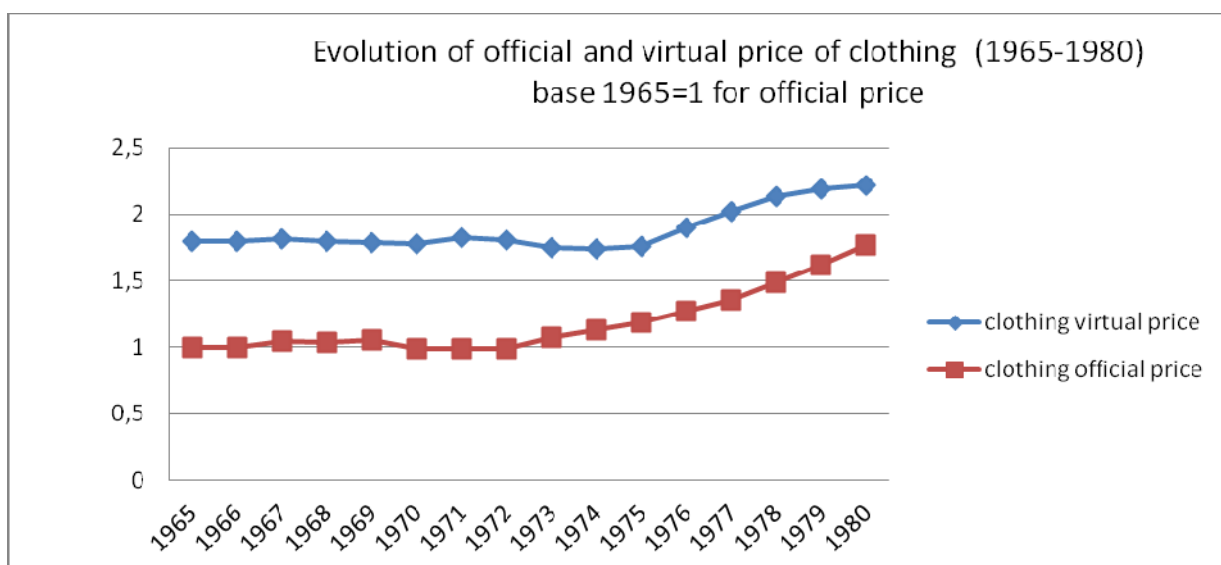
Until the end of sixties the official prices were practically stable whatever the situation on the market. In this period the difference between virtual and official prices is the largest with respect to the whole period, with few fluctuations. Between 1971 and 74 the tendency became slightly decreasing, but with strong fluctuations. The reason of this result is both the better supply on goods thanks to the petrodollar recycling through imports of consumer goods and an increase in incomes due to investment boom financed again by petrodollars. Starting from 1975 the government facing both increasing pressure of still high purchasing power and the necessity to reimburse the foreign debt decides to increase dramatically official food prices. It ends with popular protests in 1976, but the tendency to increase official prices is still present. It leads to the strong reduction of the gap between official and market equilibrium price represented by virtual price in the end of seventies. Over the whole period 1965-1980 the ratio of virtual to official price for food dropped from almost 5 in 1965 to less than 3 in 1980. Thus the official prices better and better reflect the inflationist tendency in the economy even if the difference between virtual and official prices remain high. It means that the excess demand was diminishing due to the inflation of official prices, but the structural market disequilibrium between demand and supply remained very large.

The very large difference between official and virtual prices can seem to be overestimated (up to 500% for food). However, the similar result was found by Culbertson et Amacher (1978) comparing the evolution of the exchange rate of convertible currencies in Poland and the corresponding Purchasing Power Parity (PPP). More convincing is the result of “natural experiment” of the “shock therapy” in 1990 in Poland when the market equilibrium was established very rapidly (few months) by liberalizing completely prices, cutting subsidies and strongly controlling the rise in wages. The resulting official market price level in 1990 was 686% higher than one year before the shock therapy. At this new level the demand constrained were dramatically reduced. This figure is of course not completely comparable with almost 500% gap between official and virtual price of food observed in 70ties, but the very large scale of “natural experiment” consequences on consumption prices makes very plausible the result obtained by virtual price approach.

**Graph 2**



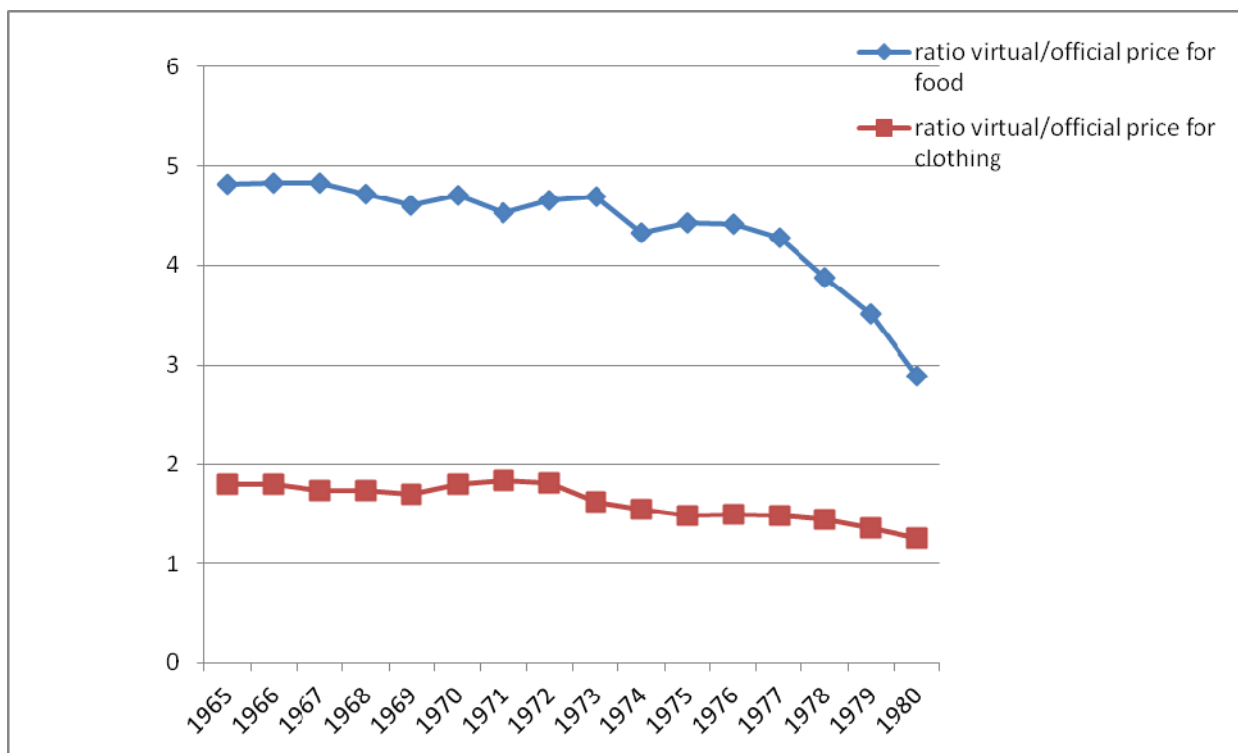
**Graph 3**





**Graph 4**

The ratio between virtual and officially reported prices for food and clothing  
1965-1980



## Conclusion

The decade of seventies was the period of inflationist tensions on the global scale caused by the successive shocks in oil prices. All countries were concerned, market economies as well as Centrally Planned Economies (CPE). The specificity of Poland in this period is that this country was entering the decade with very serious social and economic difficulties. Poland used relatively more than others the process of petrodollars recycling to boost its economy by contracting relatively cheap credits in convertible currencies. Difficulties in paying back the debt due to the structural contradiction of centrally planned economies (Kornai 1980), led to the more active austerity policies in Poland than in other CPE countries. In the context of administrated prices with high subsidies it meant the shift closer towards the market realities by the increase in official prices. The question was to what extent these policies created an extra inflationist tensions similar to those observed in market economies. The main difficulty answering this question is the meaning of inflation in CPE countries. Fixed administratively (and to large extent arbitrary) prices in CPE cannot really be used as a measure of inflation. Instead, the evolution of the distortions between supply and demand can be used as an indicator of what money can really buy. Different proxies of the demand – supply disequilibria were discussed confirming the large differences between the formal and real purchasing power of the money in Poland. All this indicators give only partial evaluation of the distance between observed official prices and the market realities. In order to obtain more global effect of market disequilibria on consumer's expenditures we used an approach taking into account the rationing effects on the whole consumption budget. We applied Neary, Roberts (1980) theoretical framework of virtual prices for rationed consumer based on the use of unconstrained demand functions to explain the behaviour under rationing. The estimation results of Linear Expenditure System specification of the model shows a very large gap between virtual and official price of food (up to 500%) which corresponds to the extra cost necessary to purchase food taking into account various constraints due to rationing at a given level of official prices. This gap is much lower for clothing (less than 200%). The size of this inflationist gap for food varies during seventies. Over the whole period 1965-1980 the ratio of virtual to official price for food dropped from almost 5 in 1965 to less than 3 in 1980. Thus, over the period the official prices better and better reflect the inflationist tendency even if the difference between virtual and official prices remains high. It means that the excess demand was diminishing due to the inflation of official prices, but the structural market disequilibrium between demand and supply remained very large.

These results, showing a huge inflationist gap are similar to some symptomatic, partial indicators of real inflation, particularly those based on the foreign currency exchange rate (Culbertson et Amacher, 1978). More importantly, these very large figures are still below the natural experiment results of the "shock therapy" in 1990 in Poland, when the market equilibrium was established within few months by liberalizing completely prices and cutting subsidies. The resulting price increase in 1990 achieving the level close to the market equilibrium was 686% with respect to the previous year (1989) still under price control regime.

## Appendix 1

Estimation results of LES model under rationing (equation 5 and 4)  
Poland 1965-1980

Parameter	Estimate	Standard error	t-value	p-value
<b>Energy <math>\gamma_3</math></b>	34.91915	2.0780	16.80	<.0001
<b>Housing <math>\gamma_4</math></b>	14.39918	17.0135	0.85	0.4127
<b>Miscellaneous <math>\gamma_5</math></b>	29.13906	23.6108	1.23	0.2390
<b>food <math>\gamma_{r1}</math></b>	496.7364	25.5309	19.46	<.0001
<b>clothing <math>\gamma_{r2}</math></b>	146.8736	18.1078	8.11	<.0001
<b>Energy <math>\beta_3</math></b>	0.001646	0.000806	2.04	0.0618
<b>Housing <math>\beta_4</math></b>	0.039858	0.0180	2.21	0.0454
<b>Miscellaneous <math>\beta_5</math></b>	0.072557	0.0326	2.23	0.0443
<b>food <math>\beta_{01}</math></b>	0.705774	0.0390	18.10	<.0001
<b>clothing <math>\beta_{02}</math></b>	0.188123	0.0268	7.02	<.0001
<b>food virtual price <math>p^v</math></b>	0.85963	0.1096	7.85	<.0001
<b>clothing virtual price <math>p^v</math></b>	1.856654	0.1999	9.29	<.0001

The model is well estimated, the main parameter estimates are significant and have correct signs. Only the subsistence expenditure on housing and miscellaneous goods are not significantly different from zero.

The main parameters of interest ( $\gamma_{r1}$  and  $\gamma_{r2}$ ) for rationed food and clothing are highly significant

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Poland 1965-1980

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The main parameters of interest ( $\gamma_{r1}$  and  $\gamma_{r2}$ ) for rationed food and clothing are highly significant

## Appendix 2

Theoretical model of household behaviour under rationing (Neary, Roberts 1980)

1. The basic idea is to extend the classic consumer behavior model using duality and the concept of virtual prices: Slutsky type equations are derived by decomposing the derivatives of constrained (rationed) demand functions into income and substitution effects and to compare them to the corresponding derivatives of the non constrained demand functions.
2. The virtual price concept is relating demand functions of the non rationed demand functions to the rationed ones (without specifying the direct utility function).
3. Budget constraint in presence of rationing:

$$\mathbf{p} \mathbf{x} + \mathbf{q} \mathbf{y} < \mathbf{b}$$

with;

$\mathbf{x}$  vector of non rationed goods ,

$\mathbf{y}$  vector of rationed goods,

$\mathbf{p}$  vector of prices of non rationed goods ,

$\mathbf{q}$  vector of prices of rationed goods,

$\mathbf{b}$  income

The quantity of  $\mathbf{y}$  is rationed to the level of  $\bar{y}$  which leads to the choice of quantity  $\tilde{x}$  of non rationed goods leading to the demanded consumer bundle  $(\tilde{x}, \bar{y})$

It can be shown that that the actual and support prices for the unrationed goods are identical. Then the bundle  $(\tilde{x}, \bar{y})$  is supported by corresponding vectors of actual prices for  $\mathbf{x}$  and virtual for  $\mathbf{y}$  .

Unconstrained expenditure function:

$$m(p, q, u) = \min[px + qy : v(x, y) \geq u] \quad (1)$$

Constrained expenditure function:

$$\tilde{m}(\bar{y}, p, q, u) = \min[px + q\bar{y} : v(x, \bar{y}) \geq u] \quad (2)$$

Relationship between (1 and 2)

Partial derivative of constrained expenditure function with respect to the ration level  $\bar{y}$  is:

$$\tilde{m}(\bar{y}, p, q, u) = m(p, \bar{q}, u) + (q - \bar{q})\bar{y} \quad (3)$$

The virtual price is defined as an implicit function of  $\bar{y}$ ,  $p$  and  $u$  by the restriction that they are those prices which would lead an unconstrained household to buy the ration level  $\bar{y}$ .

$$\bar{y} = y^c(p, \bar{q}, u)$$

Differentiating (3) with respect to  $\bar{y}$  yields a measure of the benefit (or loss) for the household of change in  $\bar{y}$ :

$$\tilde{m}_y = (m_q - \tilde{y}) \frac{\partial \bar{q}}{\partial \bar{y}} + (q - \bar{q}) = q - \bar{q}$$

The result is the same for both situations: rationing leading to  $q > \bar{q}$  or to  $q < \bar{q}$ .

Analogy with Slutsky equation for the effect on demand of a price change:

$$\tilde{x}_y = \tilde{x}_y^c + \tilde{x}_b(\bar{q} - q)$$

In the case when  $q$  and  $\bar{q}$  are close to each other there is no income effect.